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INVESTIGATION OF SEISMICALLY-INDUCED LIQUEFACTION IN THE SOUTHERN MISSISSIPPI EMBAYMENT

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ABSTRACT

Trenching of circular/elliptical sand blows (~1 m thick and ~10 to 30 m across) at three localities in Ashley and Desha Counties, Arkansas revealed multiple events of seismically-induced sand venting through ≤10cm-wide dikes. Push core data suggest an alluvial source sand 2 to 3 m deep under ~1.5m of clay. These liquefaction deposits occur on late to mid-Holocene alluvium of former courses of the Arkansas River. Two trenching localities (Montrose and Portland) are near the north and south margins, respectively, of a 15 km-diameter liquefaction field in northeastern Ashley County. The sand blows in this field are densely spaced, and the field diameter is consistent with a local paleoseismic event of M 5.5 to 6. The third trenching locality (Kelso) is within a liquefaction field 50 km to northeast in Desha County. These sand blows are more sparsely spaced than in the Ashley County field and are largely confined to natural levee deposits of abandoned Arkansas River channels.

At Montrose, two trenches were excavated. The principal (2^{nd}) venting episode produced the mapped liquefaction field. All trenched sand venting episodes post-date alluvium with a 2s Cal ^{14}C age of 5.19+/-0.133 Ka. The 1st blow (≤10cm thick) shows no soil development and is buried by the 2^{nd} blow (≤90cm thick). The top of the alluvium buried by vented sand has a 1s Infrared Stimulated Luminescence age of 6.37+/-0.55 Ka beneath the 1^{st} blow and 5.83+/-0.43 Ka beneath the 2^{nd} blow. Although slightly older, these luminescence ages are in general agreement with the ^{14}C age of the alluvial substrate. An O horizon developed on top of the 2^{nd} blow has a 2s Cal ^{14}C age of 1.43+/-0.125 Ka. The 3rd event created a 2m-wide crater filled with organic-rich sediment (2s Cal ^{14}C age of 0.69+/-0.055 at the base and 0.58+/-0.02 Ka twenty centimeters higher). In summary, Montrose data indicate two paleoseismic events between circa 5.5 Ka and 1.4 Ka (both probably close to the older date) and one event circa 0.65 to 0.7 Ka.

At Portland, one trench was excavated revealing two paleoseismic liquefaction events. Organic content of the post-sand blow soil was insufficient for radiocarbon age analysis. However, 2s Cal ^{14}C ages of 0.39+/-0.11 and 0.16+/-0.01 Ka from a fossil burrow fill post-date the sand blow, and a 2s Cal ^{14}C age of 0.95+/-0.04 Ka from charcoal recovered from the substrate alluvium pre-dates the blow. A younger sand dike cross-cuts the sand blow. The age of the surface buried by this sand blow is currently being analyzed at the University of Illinois at Chicago by Infrared Stimulated Luminescence.

At Kelso, one trench was excavated revealing at least three paleoseismic liquefaction events. Although organic contents of pre-sand blow alluvium and post-sand blow soil were insufficient for radiocarbon age analysis, organic-rich fill in three vent craters yield 2s Cal ^{14}C ages of 0.89+/-0.15 Ka, 1.14+/-0.18 Ka (these ranges overlap at ~1.0 Ka), and 2.16+/-0.15 Ka. Luminescence age analysis of the surface buried by the principal sand-venting episode yields a 1s Infrared Stimulated Luminescence

age of 5.74+/-0.56 Ka. The younger sand-venting episodes at this site may correspond to New Madrid earthquakes at ~1.1 Ka and ~2.1 Ka. The oldest event at Kelso may correspond to the triggering earthquake of the principal sand-venting episode at the Montrose site.

If these sand blows formed during large New Madrid seismic events ($\geq$250 km northeast), the area of strong ground motion for this seismic source has been underestimated. The age constraints of two of the paleo-liquefaction events documented in this study are consistent with the New Madrid paleoseismic chronology. It is uncertain if sand-venting episodes circa 6000 to 5500 ybp correspond to New Madrid paleoseismic events because the New Madrid chronology is not well documented for this time range. The last sand-venting episode at Montrose is not consistent with the New Madrid paleoseismicity chronology and may indicate a local seismic source such as the Saline River fault zone. This fault zone (previously trenched at an upland site 40 km NW of the Montrose/Portland sand blow field) shows mid/late Holocene reverse-left lateral slip and projects through this liquefaction field. Our new work on this fault (85 km NW of the sand blows) reveals a gentle anticline (trend 326^{o}) marked by a prominent 3 km-long topographic lineament. This fold (interpreted as a fault-propagation fold) deforms alluvium with a 2s Cal ^{14}C age of 0.64+/-0.085 Ka (in general agreement with the latest sand-venting at Montrose and possibly the principal venting episode at Portland).